# EUROfusion Human Resources development, training and knowledge management: NEXT steps to bringing the fusion research community to the Nuclear newbuild era

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Efficient and effective Human Resource Development (HRD) and Knowledge Management (KM) policies are imperative to the successful implementation of the long-term vision of the European Fusion Research programme, which is outlined in the EUROfusion Roadmap [1]. EUROfusion is a consortium of 30 research institutes across the European Union, the UK, Switzerland and Ukraine, with 152 affiliated entities, including universities. Together they implement Euratom’s nuclear fusion research programme. The main objectives are to prepare for ITER exploitation and to develop concepts for a DEMO fusion electricity plant.

ITER is the first nuclear facility in fusion and currently in assembly phase. With DEMO currently in the conceptual design phase, periods of up to about twenty years may be between similar project phases. Thus, effectively capturing, transferring and preserving the know-how and experience is critical to the success of the future programme. In this aspect, fusion can learn from the experience in fission. As the full lifecycle of a nuclear power plant spans multiple career lengths, it is understandable why systematic knowledge transfer and preservation activities are well-established in the fission community and why it is a safety requirement for power plants.

The European fusion research programme bears a vast amount of know-how that spans from fundamental physics research to (remote) maintenance concepts, from plasma-wall interaction to tritium fuel cycle, and other systems. Also, within the EUROfusion member institutes, an extensive experience in the operation and commissioning of experimental fusion devices exists, such as tokamaks JET, ASDEX-Upgrade, MAST-Upgrade, TCV, and WEST, stellarators like W7-X, and several smaller experiments. The success of future projects, such as ITER, will rely on the experimental and operational know-how that has been developed in the current devices. Moreover, the success of further technology development, such as for DEMO, benefits from the experience in conceptual design activities in the projects as NET (Next European Torus) and ITER in the past decades.

This paper introduces a series of observations and pilot activities with the purpose to build a comprehensive and coordinated Human Resource Development and Knowledge Management programme. Within the IAEA Technical Meeting, this has the intention to identify synergies for collaboration, invite suggestions and learn from best practices from various stakeholders in the nuclear community. From research to industry to regulator, many should gradually become more involved in future fusion projects.

Education, Training and Human Resources Development

EUROfusion provides support for close to 700 PhD students and coordination of academic education programmes in the field of nuclear fusion. In addition, every year EUROfusion supports 15 early career engineers in the form of a 3-year EUROfusion Engineering Grant (EEG) and 10 early career scientists in the form of 2-year EUROfusion Research Grants (ERG). The ERG is a postdoc scheme in which proposals to open research problems are evaluated based on excellence. The EEG topics mainly target engineering and technology challenges of the highest priority and/or scarce competences where the community needs more experts in the near future. A joint training programme has been established in 2022 to provide further training to candidates on various soft skills and generic knowledge as well as support building their network.

EUROfusion is in close collaboration with the European Fusion Education Network (FuseNet), an association with the purpose to stimulate and disseminate fusion education across Europe. Coordinated by EUROfusion, FuseNet implements various activities, including internship support for MSc students, an annual PhD Event, a Teacher Day for secondary school teachers, coordination and organisation of advanced Master workshops and the maintenance and presentation of an education material repository [2].

In 2022-2023, a Human Resource Survey will be conducted in the EUROfusion community, following a previous assessment done in 2016. The objective is to gauge the current skills and human resource status and, together with the assessment of workforce needs in the years ahead, the development of a competence strategy. In the assessment of industry, collaboration is sought with Fusion for Energy, the European Joint Undertaking for ITER and the Development of Fusion Energy, acting as European procurement agency for ITER. The survey will be discussed in a dedicated workshop in 2023 focusing as well on the current training and Human Resource practices and needs within the EUROfusion community.

Knowledge management

By its nature of a longstanding R&D programme, knowledge transfer and preservation activities already exist, in various forms. This includes conferences, publications, seminars, training activities within institutes. However, the risk of losing specialised competences is deemed high, in this high-tech research field with long development timelines. Therefore, more coordinated measures are required.

To remedy the loss risks, EUROfusion has chosen to devote more attention to a programmatic KM strategy in the recently started framework programme Horizon Europe. To raise awareness on the topic and collect needs for the KM activities, workshops are being organised with internal and external stakeholders. An additional survey among workshop participants was conducted to provide an overview of the knowledge management needs and gaps of EUROfusion. There is consensus on the importance of the topic and the need to mitigate loss of critical competences. Priority was given to the mapping, traceability and accessibility of project documentation.

Acknowledging that the fission community has longer experience with knowledge management and systematic human resource development, it is the intention of the contributors to establish collaborations in various technological areas of shared interest, such as materials, waste technology, molten salts, tritium fuel cycle and detritiation technology, remote handling, control and diagnostics, design safety and safety analysis, project management, supply chain, operation and training.

Knowledge Management pilot activities

Several pilot projects have started or are in preparation, with the objective to form building blocks of an overall strategy. The objective is to grow these activities steadily. They are briefly introduced here.

* A pilot with the collaborative platform MS365 has been started, allowing several teams from various associations and EUROfusion work packages to work collectively (share and edit document, improved communication). The goal is to make use of the additional collaborative features, which the current document management system does not provide. Within the DEMO design activity, a start will be made with a Product Lifecycle Management (PLM) system to manage the conceptual design baseline documentation;
* A mapping of the status, location and access of relevant knowledge is in development within several EUROfusion work packages and around the recent deuterium-tritium campaign of the JET tokamak. A lessons-learned database is in preparation with the template and process in a pilot phase, to capture relevant experience systematically;
* On the Garching campus in Germany, where the EUROfusion Programme Management Unit resides, physical archives are stored of technical work dating back to the 1980s, e.g., NET (Next European Torus), ITER Conceptual Design Activity, The SEAFP Project (Safety and Environmental Assessment of Fusion Power). There is interest in that a relevant selection of these documents is preserved, digitised and their contents become searchable. Currently steps are taken to preselect and classify, such that a mass digitisation activity can take place later in 2022;
* Finally, the EUROfusion Operations Network (EON) was established in 2021 to connect the operational experts across the EUROfusion facilities to share their operational know-how and experience. The EON network is organising, starting from 2022, seminars, workshops and training on various topics related to the operation of fusion devices such as tokamaks and stellarators.

Outlook and collaborations

The EUROfusion activities in Human Resource Development and Knowledge Management aim to develop a strong and consistent strategy that ensures the capability of Europe to make future phases of ITER and DEMO successful. In this way, EUROfusion actively cooperates with the ITER Organization and its European implementation agency, Fusion for Energy (F4E). EUROfusion develops cooperation on KM with F4E, which also organises internal KM activities. By exchanging best practices and joining forces in (technical) areas of common interest, the joint aim is to preserve the relevant know-how in the European programme. The Broader Approach Agreement (between the European Union and Japan) is a notable successful collaboration activity. EUROfusion further aims to seek collaboration with other stakeholders in the nuclear field such as IAEA of which its strong track record in assessments, policy advice and programme development in the nuclear sector, are deemed valuable to the human resource development and knowledge management needs in the nuclear fusion endeavour.

References

1. DONNÉ, A.J.H. et al., (2018) “European Roadmap to the Realisation of Fusion Electricity”, EUROfusion, ISBN 978-3-00-061152-0, available at <https://www.euro-fusion.org/eurofusion/roadmap/>
2. FuseNet, Fusion Education Material Browser, see: <https://fusenet.eu/education/material>